MACHAKOS UNIVERSITY

University Examinations for 2019/2020 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

FIRST YEAR THIRD SEMESTER EXAMINATION FOR

DIPLOMA IN BUILDING AND CIVIL ENGINEERING.

MATHEMATICS

DATE: 15/12/2020   **TIME: 11.30-2.30 PM**

INSTRUCTIONS

The paper consists of FIVE questions. Answer ALL.

ALL questions carry equal marks.

Show all your working

1. (a) Simplify (i) $\frac{log729 - 4log3 + 2log27}{log243 - log27 + log9}$ without using logarithm tables

      (ii) $\frac{6x^2y^3 + 2xy^2}{6xy}$ (6 marks)

    (b) Solve the equations

      i. $8x - 3y = -39$

            $7x + 6y = 9$

      ii. $\frac{3}{x-2} = \frac{5}{3x+4}$

      iii. $log2x^2 - logx = log16 + logx$ (10 marks)

    (c) Make b the subject of the formulae: $a = \frac{x-y}{\sqrt{(bd+cb)}}$ (4 marks)

2. (a) Given that $\mathbf{A} = P\mathbf{i} + b\mathbf{j} - 3\mathbf{k}$ and $\mathbf{B} = 4\mathbf{i} + 3\mathbf{j} - \mathbf{k}$ where P is a constant. Determine the value of P such that vectors $\mathbf{A}$ and $\mathbf{B}$ are perpendicular to each other.   (4 marks)

    (b) Evaluate the middle term in the binomial expansion of $(2x + 3y)^8$ and it's value when $x = \frac{1}{3}$ and $y = \frac{1}{2}$.   (6 marks)

    (c) The sum of the 4th and 6th terms of a geometric series is 80. If the product of the 3rd and 5th term is 256, determine;

i.   first term

                    ii.   common ratio

                    iii.   sum of the first eight terms   (10 marks)

3.   (a)   Prove the identity: $\dfrac{sin\theta}{1+cos\theta} + \dfrac{1+cos\theta}{sin\theta} = \dfrac{2}{sin\theta}$ (4 marks)

      (b)   The probability of a concrete mixer is $\dfrac{1}{4}$, dumper $\dfrac{1}{7}$ and hoist $\dfrac{1}{8}$ respectively.

      Determine the probability that:

                    i.   all machines breakdown;

                    ii.   two machines breakdown.   (4 marks)

      (c)   **Table 1** shows the lengths in centimeters of 50 bars in a construction site.

Length (cm)	Frequency
34-36	2
37-39	6
40-42	12
43-45	14
46-48	10
49-51	5
52-54	1

      Calculate

                    i.   Mean

                    ii.   Median   (6 marks)

      (d)   Solve the equation $3cos^2\theta + 10sin\theta = 11$ (6   marks)

4.   (a)   Express in polar co-ordinates the position:

                    i.   P$_1$ (3 4)

                    ii.   P$_2$(-5 -8)   (6 marks)

      (b)   obtain the Cartesian equations of;

                    i.   x = t^2 + 4 and y = t – 3

                    ii.   r = 5(1 + 2cosθ)   (7 marks)

      (c)   A ship sails from A (40^{0}N, 50^{0}E) to B (40^{0}N, 70^{0}W). Taking π = 3.14 and the radius
             of the earth to be 6400 Km, calculate the distance from A to B giving the answer
             correct to five significant figures.   (7 marks)

5.   (a)   Convert

                    i.   1101101 to denary

                    ii.   204 to binary   (4 marks)

(b) A minor segment is enclosed between a chord of length 14cm and a circle of diameter 20cm. determine the area of the segment. (5 marks)

(c) Two ordinary unbiased dice are thrown. Determine the probability that the:

    i.   sum of the two dice is 3;

    ii.   sum of the two dice exceeds 9;

    iii.   Two dice show the same number;

    iv.   Number on the two dice differ by more than 2. (11 marks)